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स्वचल वाहन — यांत्रिक स्टीयरिंग गियर — परीक्षण पद्धतियाँ

(पहला पुनरीक्षण)

Indian Standard

AUTOMOTIVE VEHICLES — MECHANICAL STEERING GEAR — METHODS OF TEST

(*First Revision*)

ICS 43.040.50

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

June 2006

Price Group 3

Automotive Primemovers Transmission, Steering Systems and Internal Combustion Engines Sectional Committee, TED 2

FOREWORD

This Indian Standard (First Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Primemovers Transmission, Steering Systems and Internal Combustion Engines Sectional Committee had been approved by the Transport Engineering Division Council.

This standard was first published in 1992. The revision of the standard has been taken so as to align it with the latest developments in the field.

Steering gear is a safety critical component. The purpose of this standard is to provide a guide for the manufacturers and users. In this revision the torque values required at various load conditions are given for more ranges of diametef of steering output shaft.

In reporting the result of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

AUTOMOTIVE VEHICLES — MECHANICAL STEERING GEAR — METHODS OF TEST

(First Revision)

1 SCOPE

This standard covers the methods of test for mechanical box type steering gear of automotive vehicles.

2 TESTS

The test on the mechanical steering gear of automotive vehicles shall consist of:

a) Efficiency,

b) Static load at steering input shaft,

c) Static load at steering output shaft, and

d) Wear test.

3 TEST PROCEDURES

3.1 Efficiency of the Steering Gear

3.1.1 *Test Set-up*

A typical steering output shaft set-up shall have the horizontal position and steering gear mounted on the test stand in such a way that a constant torque can be applied to the steering output shaft as for example, by means of a rope pulley and a weight (*see* Fig. 1). Fit a drive to the steering shaft such that no misalignment occurs. This drive shall allow for cycling the steering gear from lock to lock at a constant speed of 10 rev/min. The drive shaft shall be fitted with a torque transducer and an angle transducer. It shall possible for the drive to be operated by means of a hand switch (on-off and change of direction of rotation).

3.1.2 *Measurement*

Measuring shall begin in the straight ahead driving position. The drive shall rotate in one direction (for instance, right-hand turning) and the weight at the rope shall be fastened in such a way that it is lifted up as the drive operates (turning in). Just before the steering gear lock stop is reached, the direction of rotation of the drive shall be altered so that now the weight moves down and starting from the steering output shaft tries to rotate the steering gear (self-centering). Self-centering however shall be braked by the drive which even at this moment shall be rotating at a speed of 10 rev/min. The torque existing at the shaft of the drive during turning in (M_E) and during self-centering (M_R) shall be measured as a function of the steering input shaft turning angle and plotted on the *X-Y* recorder. The weight at the rope pulley shall then be relocated and the measurements as before shall be taken for the left-hand turning operation.

3.1.3 *Calculation of Efficiency* (*E*)

Based on the turning in torque (M_E), the steering output shaft torque (M_W) and the steering box ratio K, the turning in efficienty η_E at any point of the steering angular displacement shall be obtained by calculation and recorded in a graph. Also the self-centering efficienty η_R shall be calculated using the self-centering torque M_R, the steering output shaft torque M_W and the steering ratio ρ.

$$\eta_E = \frac{M_W}{M_E \times \rho}$$

$$\eta_R = \frac{M_R \times \rho}{M_W}$$

3.1.4 *Requirements*

Turning-in efficiency : $\eta_E > 75$ percent

Self-centering efficiently : $\eta_R > 0.9 \times \eta_E$

3.2 Static Load at Steering Input Shaft

3.2.1 The steering gear shall be mounted on a fixture which shall allow for the locking of the drop arm (*see* Fig. 2). A load shall then be applied to the steering input shaft but without jerk the wheel in one direction until a torque of 120 Nm for output shaft dia up to 26 mm, 160 Nm for output shaft dia between 26 mm and 32 mm, 200 Nm for output shaft dia above 32 mm. The load shall be applied in straight ahead driving position and at a drop arm travel angle of 40° or 90 percent of full lock angle. After the load has been applied the arm and the roller shall be subjected to a ferro-flux test. The same load at above shall then be applied to a second steering system in the opposite turning direction.

3.2.2 After the test the steering gear shall not show failure, crack or permanent deformation.

3.3 Static Load at Steering Output Shaft

3.3.1 The steering gear shall be mounted on the static load test fixture (*see* Fig. 2). The steering shall be fitted with a locked steering input shaft in such a way that a load can be applied to the output shaft through the drop arm actuated by a power ram. With the steering in straight ahead position the test load shall be applied quickly but without jerk in either direction of the load. The load shall be applied on the drop arm at 90 percent of end lock angle in housing in both left and right direction of output shaft (on both the sides of the arms). The worm and the output shaft shall be subjected to a ferro-flux test after the load test.

3.3.2 The steering gear shall not show failure, crack or permanent deformation when tested at the loads required for the following torques on the output shaft:

Steering output shaft up to 26 mm diameter	:	800 Nm
Steering output shaft diameter above 26 mm and upto 30 mm	:	1 850 Nm
Steering output shaft diameter above 30 mm and upto 35 mm	:	3 400 Nm
Steering output shaft diameter above 35 mm and upto 40 mm	:	4 800 Nm
Steering output shaft diameter above 40 mm	:	6 800 Nm

3.3.3 The load at which housing failure occurs shall be at least 50 percent more than the test load. In order to ascertain the housing failure load, the load shall be applied in straight ahead position and a hardened steering output shaft or a output shaft quenched and tempered to a high strength may be used.

3.4 Wear Test

3.4.1 The steering gear shall be mounted on a wear test stand (*see* Fig. 3). From a position corresponding to approximately 90 percent of full left-hand lock, the input shall be turned into a position corresponding to approximately 90 percent of full right-hand lock (one load cycle) against constant counter loads at a speed 45 ± 5 rev/min. The counter load shall be applied by a power ram acting upon the drop arm. The testing shall be done at loads required for the following torques on the output shaft:

Output shaft diameter up to 26 mm	:	150 Nm
Output shaft diameter above 26 mm and up to 30 mm	:	450 Nm
Output shaft diameter above 30 mm and up to 35 mm	:	800 Nm
Output shaft diameter above 35 mm and up to 40 mm	:	1 100 Nm
Output shaft diameter above 40 mm	:	1 600 Nm

3.4.2 After 25 000 load cycles the steering gear shall be operational and shall not show crack, material fatigue or seen excessive bearing wear. Wear on moving parts as measured in the straight ahead position in terms of backlash in the travel direction at the input shaft should not increased 50 percent of the initial value measured.

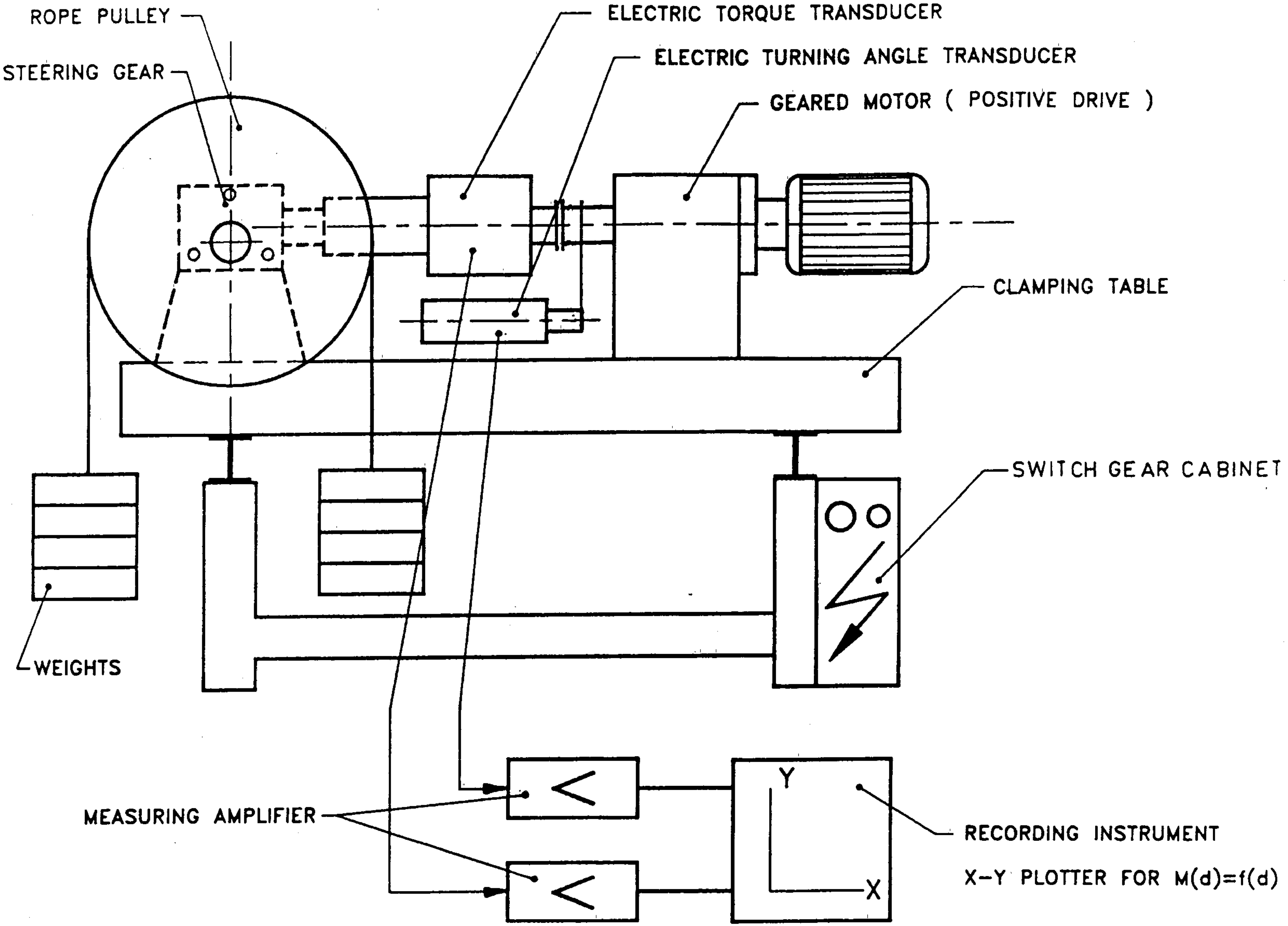
ROPE PULLEY
STEERING GEAR
ELECTRIC TORQUE TRANSDUCER
ELECTRIC TURNING ANGLE TRANSDUCER
GEARED MOTOR (POSITIVE DRIVE)
CLAMPING TABLE
SWITCH GEAR CABINET
WEIGHTS
MEASURING AMPLIFIER
Y
X
RECORDING INSTRUMENT
X–Y PLOTTER FOR M(d)=f(d)

FIG. 1 EFFICIENCY TEST RIG

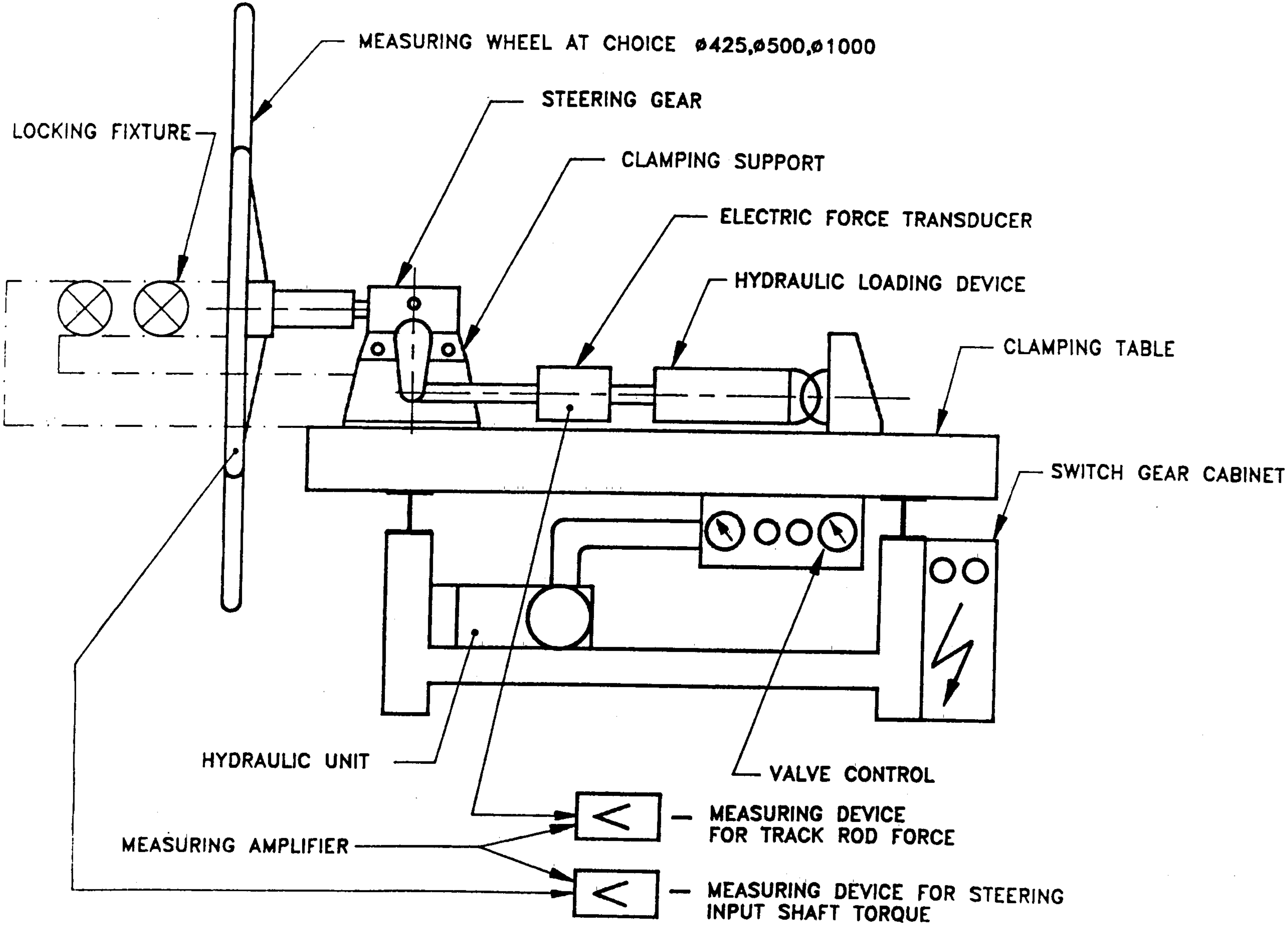
MEASURING WHEEL AT CHOICE ø425,ø500,ø1000
STEERING GEAR
LOCKING FIXTURE
CLAMPING SUPPORT
ELECTRIC FORCE TRANSDUCER
HYDRAULIC LOADING DEVICE
CLAMPING TABLE
SWITCH GEAR CABINET
HYDRAULIC UNIT
VALVE CONTROL
MEASURING DEVICE FOR TRACK ROD FORCE
MEASURING AMPLIFIER
MEASURING DEVICE FOR STEERING INPUT SHAFT TORQUE

FIG. 2 STATIC LOAD TEST RIG

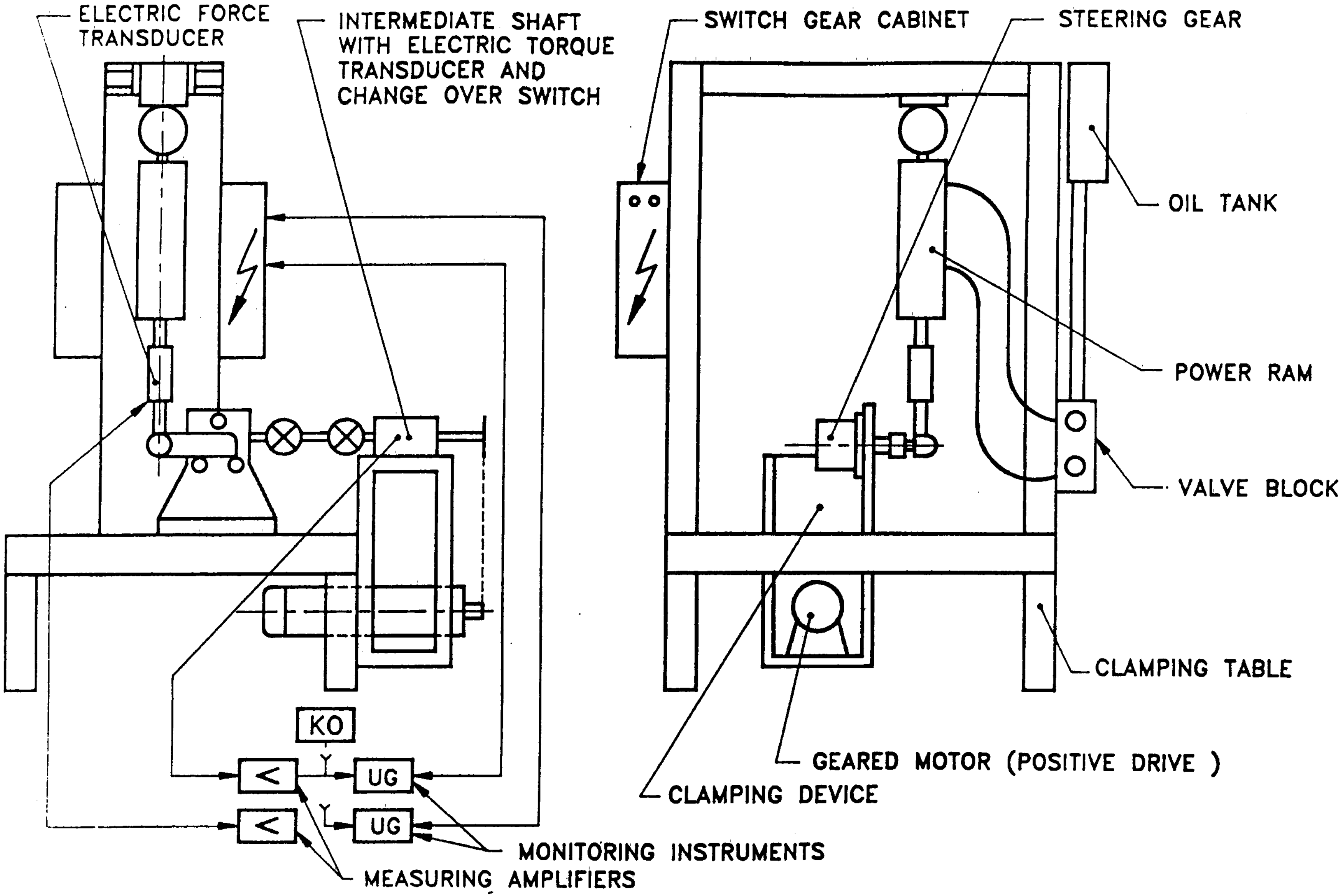

FIG. 3 WEAR TEST RIG

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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